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ABSTRACT

This book contains questions for secondary school science students that require them to analyze data presented in various forms and apply knowledge and skills developed in novel situations. The content for the questions is derived from a science curriculum developed by a group of Caribbean nations. The material is organized into four sections: (1) integrated science; (2) chemistry; (3) physics; and (4) biology. The exercises are helpful in preparing students to take standardized tests in science as they can be used to reinforce practical work related to a topic covered in the booklet, teach general skills of data analysis and observation, and provide an alternative means of skill development. The approach recommended for each problem situation includes a discussion of the experimental design and details of the experiment that produced the data. (DDR)

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Teachers' Resource Material for Integrated Science.

Ideas for Teaching Integrated Science in Secondary Schools

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Series of Caribbean Volunteer Publications

8

One of a series of publications produced by VSO volunteers in the Caribbean. Production funded by a grant from **British Development Division, Caribbean.**

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Voluntary Services Overseas **(VSO)** is an independent British Charity which works to assist countries in the Caribbean, Africa, Asia and the Pacific to achieve their development aims and create a more equitable world. VSO volunteers work alongside people in poorer countries in order to share skills, build capabilities and promote international understanding and action.

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VSO would like to extend their appreciation and gratitude to the following people who have made this series of publications possible:

- British Development Division (BDDC) for providing the funding for this series of publications
- Volunteers and local colleagues contributing to production of publications.
- Organisation of Caribbean Overseas Development (OCOD) for assisting in the reproduction of these publications

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Other publications in this series include:

Maths and Science

1. A Practical Workbook for CXC Biology
2. Data Analysis Questions for Science Subjects. A Resource Booklet
3. Exercises and Activities in Basic Number Work
4. Fractions. Activities and Exercises for Teaching Fractions in Secondary Schools
5. Lower School Maths. Lesson Plans and Activities for Ages 7 -9 Years.
6. Maths and Science Booklet
7. Teaching Directed Numbers at Secondary School Level
8. Teachers' Resource Material for Integrated Science. Ideas for Teaching Integrated Science in Secondary Schools.
9. Upper School Maths Lesson Plans and Activities for Ages 9 -11 Years

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10. An Introduction to Children with Special Needs for Teachers in Mainstream Education
11. The Alpha Centre: A Special School for Special Children. A Curriculum Checklist for Special Educational Needs.

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Many of these publications derive from projects or workshops funded through **VSO's Community Project Scheme** - an initiative also funded by grant from British Development Division, Caribbean.

FOREWARD

Voluntary Service Overseas, an independent British charity, is responsible for the deployment of some seventy volunteers currently working in various parts of the Caribbean, about a third of whom are science teachers. In the past, workshops have been organised annually for these teachers in an effort to adapt their teaching skills to the requirements of the recently introduced CXC syllabus. This year, however, it was considered more beneficial in the long term to hold a series of workshops on individual islands that would be attended by both volunteers and their science teaching colleagues. The production of these six workbooks is designed to coincide with these workshops and to provide a useful resource package for the schools thereafter.

VSO would like to express its gratitude to Mike Ratcliffe, British Development Divison's Regional Science Education Adviser to the Caribbean, and John Kuusk, VSO volunteer science teacher at Anglican High School, Bequia, St Vincent, who are responsible for compiling the materials; to all the science teachers throughout the Eastern Caribbean whose suggestions and comments have proven to be a most valuable resource and guide; and to the British Development Division for its contribution to the costs of production.

Voluntary Service Overseas
Caribbean Field Office
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INTRODUCTION

1. Increasingly, Science curricula and public examinations demand that students can analyse data presented in various forms and apply the knowledge and skills gained in novel situations. This booklet is designed to provide Science teachers with suitable resource material to meet these demands. The content of the questions is derived from the present CXC syllabus for Single Sciences and Integrated Science as well as the existing junior secondary Science programmes used in the Region.

2. Format of the Booklet

The booklet is divided into four sections:-

Section A: Form 1 - 3 Integrated Science
Section B: CXC Chemistry
Section C: CXC Physics
Section D: CXC Biology

For convenience the material has been split up into the traditional Science areas. Nevertheless, these will be useful material for CXC Integrated Science in all Sections of the booklet. In addition, because the skills tested by the material are common to all the Sciences, it is anticipated that there will be considerable overlap between the Sections. It is recommended that when teachers are about to teach any topic they consult the Contents page to identify useful material.

3. Use of the Booklet

It is important that the booklet can be used in several ways:-

(i) to reinforce practical work related to a topic covered in the booklet.

(ii) to teach the general skills (called Enquiry Skills in CXC syllabi) of data analysis and interpretation.

(iii) in some cases to provide an alternative way of developing some of the skills required by practical examinations especially when equipment constraints limit the amount of practical work possible in schools.

The use (iii) of the booklet is perhaps the most important. When students are unable to carry out more aspects of practical work, the data in the booklet can act as a substitute. Used in this way, the following approach is recommended:-

A. Discussion of the Experimental Design.
B. Details of the Equipment and its Setting Up.
C. Presentation of Specimen Data (from the booklet).
D. Analysis and Interpretation of the Data (from the questions attached).
E. Clarification of the Scientific Principles associated with the Data.

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It is vital that the students are 'actively' involved in each of the stages, if they are to derive maximum benefit from the 'practical experience' associated with the questions.

Where possible, the data is derived from 'real' practical situations. It is intended that teachers will use the materials as a source of ideas for practical work they can do with their students. Students would then analyse their own data. That in the booklet can be used as a follow-up exercise. Whatever way, the important move is that in both 'theory' and 'practical' lessons students must be 'active'. This material is designed to provide teachers with ideas on 'active' learning situations in theory lessons.

Teachers complain that students have difficulty applying knowledge and concepts in new circumstances. In our experience it is the responsibility of teachers to develop these Enquiry Skills. Presently there is little useful material available to assist teachers. It is our hope that the booklet will provide a useful source of ideas from which teachers can develop their own material.

Teachers' comments on the content of the booklet and its usefulness for teaching Science at all levels can be sent to:-

Mr. A. Ratcliffe
Regional Science Education Adviser
c/o Ministry of Education
Roseau
Dominica

Tel. 3363

20th October, 1985

M. Ratcliffe
J. Kuusk

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FORM 1 - 3 INTEGRATED SCIENCE

1. Burning a candle - Measuring Heights

Josiah was given a candle 20 cm. in length by his teacher. He measured the length of the burning candle every 2 hours. The results were:-

Length/cm.	20	18	16	14	12	10
Time/hours	0	2	4	6	8	10

(a) Make a bar-chart of the results (length as y - axis).
(b) Why does the candle become shorter?
(c) Estimate the length of the candle after 5 hours and 12 hours. Show your working.

EXTRA

(d) Plot a line graph of length (y-axis) against Time (y-axis).
(e) From the graph find the decrease in length per hour.
(f) Read off the length of the candle after 7 hours.
(g) If the length of the candle is 17 cm., how long has it been burning?

2. Measuring the length of a Bean

Mary was asked to find the length of a bean seed. She found that it was too small to be measured accurately with a ruler. She lined up the beans in rows of 10 and then joined them together. She measured the length after adding a new row. Her results were:-

Length/cm.	16	31	45	59	75	90
No. of beans	10	20	30	40	50	?

(i) Make a bar-chart of the results (Length as y-axis).
(ii) Estimate the length of seven (7) rows of beans.
(iii) How many beans give a length of 90 cm?

EXTRA

(iv) Plot a line graph of the results.
(v) From the gradient find the average length of ONE bean.

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3. Find the thickness of a sheet of paper

Vivian was told by his teacher to work out how to find the thickness of one sheet of paper using a ruler. Vivian used a thick text book containing 500 sheets. He measured the length of every 100 sheets. The results were:-

Thickness/cm.	1	2	3	4	5
No. of sheets	100	200	300	400	500

(i) How many pages in the book? (THINK!)
(ii) Make a bar-chart of the results (Thickness, y-axis).
(iii) What is the thickness of one sheet of paper. Show your working.
(iv) How thick is the book up to page 300?
(v) Vivian measured a thickness of 3½ cm; which page did he reach?

EXTRA

(vi) Plot a line graph of the results.
(vii) Find the average thickness of one sheet of paper.

4. Finding the volume of One Drop of Water

Carol was told by her teacher to find the volume of ONE drop of water using only a dropper and 25cm^3 measuring cylinder. At first she was puzzled because one drop is so small. Eventually she used the following method and results.

Volume/cm^3	0	3cm^3	6cm^3	9cm^3	15cm^3	24cm^3
No. of Drops	0	100	200	300	500	800

(i) Plot a bar-chart of the results (Volume as y-axis).
(ii) What is the volume of ONE drop. How did you estimate it?
(iii) How many drops give a volume of 12cm^3.

EXTRA

(iv) Plot a line graph of the results.
(v) From the gradient of the graph, find the average volume of ONE drop.
(vi) When Alice did the same experiment, 600 drops had a volume of only 12cm^3. Can you say why.

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5. Finding the mass of one 'Split Pea'

The teacher asked a Form 1 class to find a mass of one split pea using a balance that weighed to the nearest 5g. She split the class into 6 groups and asked each group to count out 1000 peas. Each group's peas were added to the balance in turn and the masses noted. Their results were:-

Mass/g	10g	21g	36g	40g	51g	66g
No. of peas	1000	2000	3000	4000	5000	6000

(i) Make a bar-chart of mass (y-axis) against the number of peas.

(ii) Estimate the mass of one split pea. Show your calculation.

(iii) Which results looks out of place in the table. Can you think what error may have caused it?

EXTRA

(iv) Use a line graph to find the mass of ONE split pea.

6. Stretching an Elastic Band

Judith was given the following items by her teacher:-

- one elastic band, 20 cm long.
- five identical small stones (each 20g) and a large stone Y (unknown mass).
- a nail, 5cm long.
- a tin lid with three holes on the rim.
- three short pieces of twine.
- a pin, 5cm long.
- a 50cm. rule.

The teacher asked Judith to devise an experiment to find the mass of stone Y. Judith set up her experiment on a tree trunk in the school yard and got the following results:-

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Mass on Elastic/g	Length of band/cm	Extension of Band/cm
0	20	0
20	24	?
40	28	?
60	32	?
80	36	?
100	40	?
Y	34	?

(i) Draw a diagram of the apparatus Judith set up on tree trunk.

(ii) Fill in the extensions for each mass in the table above.

(iii) Draw a bar-chart of extension (y-axis) against mass.

(iv) What is the mass of the big stone Y. Show your working.

(v) If the stone Y was split in half, what extension would there be for one piece of Y?

7. <u>The Pendulum</u>

A student measured the number of swings in 60s for a pendulum of different lengths. The results were:-

Length of Pendulum/cm	20	40	60	80	100
No. of swings/min.	67	47	38	33	29

(i) Plot a line graph of swings (y-axis) against length (x-axis)

(ii) Read off the no. of swings per minute for a pendulum of length 50cm?

(iii) A piece of plastic was added to the pendulum. For l = 100 cm, the number of swings was 29. What can you deduce?

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8. Mixing Salt and Water

Evelyn added table-spoonfuls of salt in water in a paper cup measuring the mass of salt/water each time. Her notebook showed the following results:-

Expt.	Spoonfuls added	Mass/g	Observation
1	0	200	clear
2	2	210	clear
3	4	221	clear
4	6	230	clear
5	8	241	clear
6	10	250	White solid at bottom
7	12	260	White solid at bottom

(i) Plot a bar chart of mass (y-axis) against no. of spoonfuls.

(ii) What volume of water did Evelyn start with?

(iii) Estimate the mass of one spoonful of salt. Show your working?

(iv) What is the white solid Evelyn saw?

(v) What does her observations for 10, 12 spoonfuls tell us?

(vi) The clear liquid from experiment 7 was poured into another paper cup and weighed. What would the mass be? Give your reasoning.

9. Measuring the Temperature of 'Moth Ball Liquid'

Rodney melted some moth balls in a boiling tube. He measured the temperature of the liquid each minute as it cooled down. His results were as follows:-

Temperature/C°	80	74	69	65	62	62	62	62	59	56	53
Time/Min.	0	1	2	3	4	5	6	7	8	9	10

(i) Plot a line graph of Temperature (y-axis) against Time (x-axis)

(ii) What is the M. Pt. of 'moth balls' (naphthalene).[2]

(iii) What would Rodney observe in the 4th minute?

(iv) What has happened by the end of the 7th minute?

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10. Sulphoric Acid and Water - a 'Hot Reaction'

Janie's Science teacher added ONE drop of concentrated sulphoric acid to 20cm^3 of water and measured the temperature rise. Then she added more drops, recording the temperature each time.

NOTE: Janie was told this experiment is too dangerous for pupils to carry out! DANGER!!

No. of days	0	1	2	4	8	10	14
Temperature/$^\circ$C	28	31	34	41	53	60	89
Temp.Rise/$^\circ$C	0	3	?	?	?	?	?

(i) Fill the temperature rises in the table.

(ii) Plot a line graph, Temperature Rise (y-axis) vs. Number of days.

(iii) Find the gradients of the line.

(iv) What is the average temperature rise for ONE drop.

(v) In which experiment does it appear that the teacher miscounted the drops?

11. Breeding Mice - A population explosion

Clive was breeding mice in a shed in his father's yard. Each week he counted the number of mice in the shed. The population of mice was:-

Population	2	4	16	200	600	1000	100
No. of weeks	4	9	15	21	30	40	60

(i) What can you say that the original two mice Clive started with?

(ii) Plot a line graph of the figures (population y-axis)

(iii) Explain the shape of the graph.

(iv) Suggest possible reasons for the change in population over the last 20 weeks.

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12. Lung Capacity - Blowing Up a Balloon!

Celia blew as hard as she could into a big soft balloon. Her friend Jennifer measure the volume. Celia repeated this six more times and as the balloon expanded, the volume was measured each time. Jennifer noted these figures in her book.

Volume/litres	1.5	3.1	4.5	5.9	7.5	8.5	9.3
Blows	1	2	3	4	5	6	7

(i) Plot a line graph of these results (Volume - y - axis)

(ii) Explain the shape of the graph.

(iii) What is Celia's average lung capacity?

(iv) Think of a way Jennifer could measure the volume of the balloon.

13. 'Burning Time' of a Candle

Jars of various sizes were inverted over a lighted candle. The time before the candle went out was recorded in each case. The recorded results of Maggie were:-

Burning Time/s	10	21	52	100	120	250	410
Volume of Jar/cm^3	50	100	250	400	600	1200	2000

(i) Plot a bar chart of Time (y-axis) vs. volume.

(ii) How long would a candle burn under a 200 cm^3 jar.

(iii) The 400 cm^3 jar was a beaker with a clip. Can you explain how this affected the burning time?

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14. Voltage of Dry Cell

A Science teacher gave Johnny eight new bulbs and told him to find the voltage of them. To save time Johnny joined them together and measured the voltage drop across various combinations. The results were:-

Voltage/r	1.4	2.9	4.5	6.1	7.5	8.9	10.4	10.9
No. of Bulbs in Series	1	2	3	4	5	6	7	8

(i) Plot a line graph of Voltage (y-axis) vs. the number of cells in series.

(ii) From the gradient find the average drop across a new lamp.

(iii) What do you conclude about the 8th lamp to be joined in series?

(iv) Draw a circuit diagram for the experiment.

15. Current Across a Lamp

Johnny did a second experiment to measure the current across a bulb using an amniter and one 1.5v cell. He recorded a valve of 0.3A. He then repeated the experiment using 2, 3, 4.... etc. cells. His notebook gave the following results.

Current/A	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.2
No. of cells	1	2	3	4	5	6	7	8

(i) Draw a current diagram for 3 cells used.

(ii) Plot a bar-chart of current (y-axis) vs. No. of cells.

(iii) What can you say about the last cell to be added.

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16. Magnesium Dissolving - How Fast?

Rex was given an acid of strength 10 and a piece of magnesium ribbon 3 cm. long. The ribbon 'fizzed' and took 20s to dissolve completely. He then added water to some of this acid to make strength 5, strength 2.5 and so on. He measured the time for 3 cm. ribbon to dissolve in each case. His results were:-

Strength	10	5	2.5	1.0	0.5
Time/S	20	40	80	200	400

(i) Draw a graph of Time (y-axis) vs. Strength of Acid.

(ii) Read off the graph how long it takes for ribbon to dissolve in Strength 2 acid.

(iii) Can you explain the shape of the graph.

EXTRA

(iv) Plot a graph 1/Time vs. Acid Strength.

(v) How long will it take for Strength 4 and to dissolve the ribbon.

(vi) Why do we use 3 cm. of ribbon each time?

(vii) What is the 'fizz'?

17. Measuring Force : The Newton

Different masses were hung on a spring balance. The force (in Newtons, N) for each mass was noted. The results were as follows:-

Mass/Kg	0.2	0.6	1.2	2.0	5.0	7.5
Force/N	2.0	6.0	12.0	20.0	50.0	75.0

(i) Plot a line graph of Force (y-axis) vs. Mass.

(ii) What force is exerted by a mass of 400g.

(iii) What mass will exert a force of 17.0N?

(iv) What is the ratio $\frac{\text{Force}}{\text{Mass}}$; What are the units of this ratio.

(v) If we used a mas = 1kg, what is the force exerted ... is the importance of this valve?

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18. Force, Distance and Energy

A teacher put the following table of results on the board.

FORCE (N)	DISTANCE (m)	ENERGY (J)
1	1	1
2	1	2
2	2	4
4	3	A
3	B	9
5	2	C
2.5	D	10
E	2	12

(i) What do N, m and J stand for?

(ii) Find the values of A, B, C, D, E.

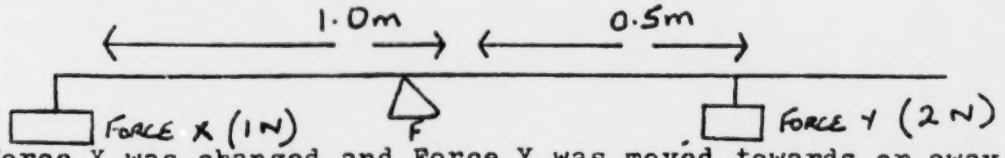
(iii) What is the link between Force, Distance, Energy.

(iv) In one experiment the Force and Distance were equal. The energy was 9J. Find N, m.

(v) In another experiment, the Force was double the distance; E = 8. Find N, m.

19. Levers - A Puzzle

A lever was set up as follows:-



The force X was changed and Force Y was moved towards or away from F to maintain balance. The results were:-

Force X/N	0.4	0.8	1.0	1.4	1.8	2.0
Distance of Y from F /m	0.2	0.4	0.5	0.7	0.9	1.0

(i) Draw a line graph of Force X (y-axis) vs. Distance Y.

(ii) Find Y distance for Force X = 0.6N; Force X = 1.5N.

(iii) Find Force X if Force Y placed at 0.6m and 0.8m?

(iv) Can you see the mathematical relationship between the Forces X and Y and their distances from F.

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20. Investigating Earthworms

Form 2 needed to collect earthworms using soap solution poured onto the ground within a given area. ($1m^2$). Each group was given scrap solutions of varying concentrations. The results were as follows:-

No. of Earthworms per m^2	6	18	43	50	40	21	6	2
Concentration of Scrap Solution	1	5	10	20	25	30	50	75

1. Draw a bar graph from the results.
2. Which concentration of scrap solution obtained the most worms.
3. What was the total number of earthworms caught?

21. Germination

Some cow peas were placed inside a vacuum flack with a laboratory thermometer and over a period of time the temperature of the germinating seeds was recorded.

Time (hrs)	0	2	4	6	8	10	12
Temp (^oC)	30^oC	32^oC	36^oC	37^oC	38^oC	47^oC	50^oC

1. From the table of results, plot a line graph showing how the temperature increased over the time.
2. What was the Highest recorded temperature?
3. What was the total rise in temp.?
4. Over which period of time was the largest temperature increase?
5. What was the temperature after 9 hours?

EXTRA

6. Predict the temp. in the flash after 24 hours.
7. Give your reasons for the above answer?
8. Explain why the temperature inceases as the peas are germinating.
9. What would be the results if the peas were placed in a flask with no water?

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23. Cont'd

	GROUPS				
ANIMALS	A	B	C	D	E
PERIWINKLES	-	-	-	80	-
LIMPETS	260	-	3	110	500
BARNICLES	-	112	5	217	-
TOP SHELLS	6	-	-	-	20
SEA URCHINS	4	-	-	-	16
CRABS	12	1	4	5	2
SEAWEEDS	-	-	-	-	-
GREEN	-	✓	-	✓	-
BROWN	✓	✓	✓	-	✓
RED	✓	-	-	-	✓

1.
From the results in the table, which of the groups were in the following zones on the rocky shore?

(i) Splash Zone.
(ii) Tidal Zone.
(iii) Permanently wet.
(iv) Intermittently wet.

2. How do you arrive at the above answers? Give your reasons.

3. Why do we only find green seaweeds in groups B and D?

4. Which zones do limpets prefer to be in, and why?

5. Crabs were found in all zones, why is this?

6. See if you can find out the latin names for some of the organisms found on the beach.

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22. Soil-Keeping - hold of water

Various types of soil were placed in filter funnels and 50cm³ of water was poured onto the soil. A measuring cylinder beneath each funnel called the water and the time for each funnel to stop dripping was recorded.

SOIL	TIME (min)
A	3 min
B	8 mins.
C	30 mins.
D	1 min.
E	0.5 30 secs.
F	15 mins.

1. Plot a bar graph to illustrate the water retention properties for each of the soils.
2. Draw up a league table showing which soils show the better water retention properties.
3. Why do we not collect the same amount of water in the measuring cylinder as we poured in?

EXTRA

4. Which soils would be classed as good loam soils?
5. Which soils would not be best suited for growing crops in?
6. Which soils would be classed as clay soils.
7. How may the water return properties of soil E be improved.

23. Rocky Shore

Form 2 went to a small rocky shore near their school to identify and count numbers of plants and animals in a given area. Each group sampled a different area along the beach and when they returned to the laboratory they drew up a table.

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24. Animal Habitats

The following table shows the living and feeding habits of a group of animals.

ANIMAL	Where it lives		When it feeds		Animals home		
	Wet	Dry	Day	Night	Air	Water	Land
Frog	✓			✓		✓	✓
Spider		✓	✓	✓			✓
Lizard		✓	✓				✓
Cockroach		✓		✓			✓
Sparrow		✓	✓		✓		
Butterfly		✓	✓		✓		
Caterpillar		✓	✓				✓
Woodlouse	✓?	✓	✓	✓			✓
Land Crab	✓		✓			✓	✓
Rat		✓		✓			✓

Using the information given in the table, answer the following questions.

1. Make a list of those animals who prefer to feed at night, and then say why this is so.

2. Which animals feed both in the day and at night time.

3. Which animals live in both water and on the land. Why do they need to do this?

4. Which particular habitat does the woodlouse prefer to live in, and why?

5. The spider mostly feeds during the day, why is this so?

6. Lizards would find it difficult to feed at night. Give two reasons for this.

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25. Photosynthesis: Making food out of Sunshine

Eight groups in the form 3 Science class were each given a small potted specimen of watergrass. (Trandescantia), with 16 leaves on each. Group A removed all the leaves except 2, group B leaving 4 leaves and so on, with group H leaving all 16 leaves in tack. The growth of the plants was then measured after a period of 1 week.

No. of leaves	2	4	6	8	10	12	14	16
Growth of Plant (cms)	.5	1.2	1.9	2.5	2.9	3.4	3.9	4.5
Group	A	B	C	D	E	F	G	H

1. Plot a line graph using the above results
2. What conclusions can you draw as to the relationship between the growth of the plant and the number of leaves.
3. Why does the number of leaves effect the growth rate of a plant.
4. Will the number of leaves/growth rate relationship reach an optimum number for all plants?

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26. A Weighty Problem

The weights of the boys and girls in school were recorded over a period of 5 years. The results were as follows:-

AGE (yrs)	WEIGHT (kg.)	
	BOYS	GIRLS
11.0	32	33
11.5	33	34
12.0	34	36
12.5	37	39
13.0	43	45
13.5	45	47
14.0	49	48
14.5	53	49
15.0	59	49
15.5	61	50
16.0	63	50

1. Plot line graphs for both boys and girls using a key for each line.
2. At which ages do one see similar weights, and explain why this is so.
3. Over what period of time do boys and girls gain most weight.
4. Explain why, at the age of 16 years, the boys weigh more than the girls.
5. Between the ages of 11 to 14 years why do an average girl weigh more than boys.
6. Will the gap between weights continue into adult life, and what circumstances may affect this.

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27. Growth in plants (seedings)

Watching seeds grow

Some maize seeds were planted in soil by Justin and each day he measured how much the shoots had grown.

Height (cm)	.5	2	3	.6	10	20	25	29	31	34	40
Time (days)	1	2	3	4	5	6	7	8	9	10	11

1. Draw a bar graph using the results.
2. On which day did the seeding make the most growth?
3. What was the average increase in height over the period?
4. Why do you think the seeding grown faster as its gets older?

5. Do all seedings grow at the same rate? Design an experiment to varify your answer.

28. CXC CHEMISTRY

1. One mole of Different Substances

A student weighed out the masses of different amounts of elements. X, Y and Z.

Amount/mole	0.1	0.2	0.5	0.8	1.2	1.6
Mass X/g	3.2	6.5	16.1	25.5	38.3	51.2
Mass Y/g	2.4	4.7	12.1	19.2	28.7	38.4
Mass Z/g	10.8	21.5	53.8	86.5	129.5	172.4

(i) On the same graph plot the masses of X, Y and Z (y-axis) vs. amount of substance.

(ii) From the graph find the mass of 1 mole of X, Y and Z.

(iii) What is the mass of
(a) 1.8×10^{23} atoms of X.
(b) 3.6×10^{23} atoms of Y.
(c) 5.4×10^{23} atoms of Z.

(iv) Identify X, Y and Z.

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29.

2. Electrolysis : The Mole

A solution containing M^{1+} ag was electrolysed for several days. The mass of Metal M was recorded at different times with a constant current of 1A.

Mass M/g	3.2	6.4	12.8	48.0	72.0	96.0
Time/s x 10^4	1.0	1.9	3.8	14.41	21.6	28.9

(i) Plot a graph of Mass (M) (y-axis) vs. Time.

(ii) Find T for M = 9.6g.

(iii) Find M for T= 10^5s.

(iv) In theory it takes 1.92 x 10^5s to deposit 1 mole of M; Find R.A.M. of M.

(v) What is the change on the cation M^{2+}aq.

30.

3. Metal Carbonate - Acid Reaction

Raymond was studying the amount of 1M sulphuric acid required to dissolve different amounts of metal carbonate McCO3. The equation is:-

M2Co3 (aq.) + H2So4 (aq). ⟶ Na2So4 (aq). + CO2 (g). + H2o.

His results were as follows:-

Mass M_2Co3/g	5.3	10.6	26.5	42.4	84.8	132.5
Volume of 1M H_2So4/cm	50	105	255	415	850	1250

(i) Plot a graph of Mass M (y-axis) vs. Volume of acid.

(ii) For M = 30g, Find volume.

(iii) For V = 1000cm^3, Find Mass M.

(iv) From 3 find the mass of 1 mole of M2Co3.

(v) Find the relative atomic mass of metal M.

31.

4. Metal Ion - Hydroxide Reactions

A cation $M^{2+}ag$ was precipital with 1M sodium Hydroxide using different volumes of 1M solution of $M^{2+}ag$. The mass of hydroxide was weighed each time.

Mass $M(OH)_m/g$	6.0	12.0	20.2	54.2	95.9	182.0	305
Volume of 1MOH/cm^3	150	100	250	450	900	1500	2500

(i) Plot mass (M) (y-axis) vs. Volume of 1M OH ag.

(ii) What mass of M (OH/2) will be precipated by V = $1000cm^3$.

(iii) Find the mass of 1 mole $(OH)_2$.

(iv) Find R. A. M. of metal M.

32.

5. Stoichimetry of Reactions : Chloride Pptation

Rachel was studying the reaction between X^{n+} and CL^- ag which gives a white 11

$X^{n+}q + nCL^-$ ag $\longrightarrow$ XCLn (s).

Her results showed the following pattern.

Volume 1M,$X^{n+}ag$	5.0	10.0	15.0	20.0	25.0	30.0	35.0
Volume of $1Mcl^{1-}ag$	9.8	20.1	29.8	40.2	50.5	61.0	69.9

(i) Plot a graph of volume $X^{n+}ag$ vs. Volume Cl^-ag.

(ii) Find the gradient of the line graph.

(iii) Find the value of n.

(iv) Complete the chemical equation for the reaction.

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33.

6. The Magnesium - Acid Reaction

1 mole of magnesium (24g) was reacted with different volumes of an acid of unknown concentration. The volume of gas evolved was recorded. A student recorded these results.

Volume of gas/l	0	3.0	6.1	12.3	19.3	30.2
Volume of acid/cm^3	0	62	125	250	400	625

(i) Plot a line graph of volume of gas (y-axis) vs. Volume of acid.

(ii) What volume of acid is required to produce 24l of gas.

(iii) Given the equation $Mg(s) + 2H^+ag \longrightarrow Mg^{2+}ag + H2$ What is the concentration of the acid?

(iv) Why are the gas volumes slightly higher than the theoretical values expected?

34.

7. Precipitation Reactions : Quantitative Approach

Different volumes of 0.5M solutions of $M^{n+}ag$. were mixed with $25cm^3$ of 0.5M KI solution. The mass of precipitate was measured in each case. The results were recorded.

Mass of ppt/g	1.0	2.0	3.0	4.0	5.0	5.0	5.0
Volume of $M^{n+}ag$	2.5	5.0	7.5	10.0	12.5	15.0	17.5

(i) Plot mass of precipitate (y-axis) vs. volume of $M^{n+}ag$.

(ii) Explain the shape of the graph.

(iii) How many moles of I^-ag react with 1 mole of $M^{n+}ag$.

(iv) Write an ionic equation for the reaction.

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35.

8. Formula of a Gas

The mass of different volumes of phosphorus vapour was measured at room temperature and pressure.

Volume /l	5	10	15	20	25	30	35
Mass/g	25.8	51.7	77.4	103.0	129.0	156.0	181.0

(i) Plot a line graph of Mass (y-axis) vs. Volume.

(ii) What is the mass of 24dm^3 of phosphorus vapour.

(iii) Find the molecular formula of the vapour (P = 31).

36.

9. Molar Volumes of Gases

The volumes of different masses of different gases were measured at RTP.

Gas	CO	H_2S	NO_2	HCl	O_2	NH_3
Mass/g	1.4	3.4	6.9	7.3	8.0	5.1
Volume/dm^3	1.2	1.4	3.6	4.8	6.0	7.2
Moles of gas						

(i) Fill in the moles of gas in the table for individual gases.

(ii) Plot a graph of volume (y-axis) vs. moles of gas used.

(iii) Find the gradient of this line. What is the significance of the value?

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37.

10. Comparing Fertilizers

For the following fertilizers:-

ammonium sulphate	$(NH_4)_2So4$
ammonium nitrate	$NH_4\ NO_3$
calcium nitrate	$Ca\ (NO_3)_2$
urea	$Co\ (NH_2)_2$
ammonium	NH_3

(i) Calculate the % of nitrogen in each.

(ii) Make a bar chart % nitrogen (y-axis) vs. fertilizer.

(iii) Ammonium sulphate solution has a pH5. Why is this a disadvantage for a fertilizer?

(iv) Calcium nitrate contains a low % of nitrogen. Yet it is a valuable fertilizer. Why?

(v) All of the above are soluble. Why is this important?

38.

11. Reaction Rates : Counting Bubbles

Many studied the rate of reaction between marble chips ($Caco_3$) and hydrochloric acid by counting the bubbles of gas produced. She carried out the experiment using 25cm^3 of 0.5M and 0.25M acid. Her results were:-

Time/s	0	60	120	180	240	300	360	400	480
Total Bubbles(0.5M)	0	130	200	250	280	300	310	315	315
Total Bubbles(0.25M)	0	80	130	160	180	190	195	198	198

(i) For both concentrations, plot total bubbles (y-axis) vs. Time (on the same graph).

(ii) Which reaction goes faster? How can you tell?

(iii) Why does one reaction go faster?

(iv) When does the reaction stop? Explain your answer.

(v) Sketch on the same graph, the results you would expect if 25cm^3 of 1.0M acid used.

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39.

12. Reaction Rates : A puzzle

A reaction between substances X, Y and Z was studied. The reaction was:-

$$X + Y + Z \longrightarrow \text{products.}$$

The effect of each substance X, Y and Z on the reaction rate was studied by varying each one in turn e.g X keeping the concentration of the other two constant. The results were:-

Rate	50	25	12.5	6.3	3.2	1.6
Concentration X	12	6	3	1.5	0.8	0.4

Rate	100	25	6.3	1.6	0.4	0.1
Concentration Y	12	6	3	1.5	0.8	0.4

Rate	20	20	20	20	20	20
Concentration Z	12	6	3	1.5	0.8	0.4

(i) Plot reaction rate (y-axis) vs. concentration for X, Y and Z.

(ii) Explain the shape of the three graphs.

(iii) Complete the following having studied the three graphs.

Concentration X = 24 ; Rate =

Concentration X = 0.2 ; Rate =

Concentration Y = 24 ; Rate =

Concentration Y = 0.2 ; Rate =

Concentration Z = 12 ; Rate =

Concentration Z = 0.2 ; Rate =

40.

13. **Atomic Structure**

Complete the following table:-

Atom/Ion	No. of Protons	No. of Electrons	No. of Neutrons	Electron Arrangement
$^{14}_{7}N$	7	7	7	2.5
$^{16}_{8}O$				
$^{18}_{8}O$				
$^{40}_{18}Ar$				
$^{39}K^{+}$				
$^{32}S^{2-}$				
$^{238}_{92}U$				
$^{37}_{17}Cl$				

(i) $^{16}_{8}O$ and $^{18}_{8}O$ are ----------?

(ii) What do Ar, K^{+} and S^{2-} have in common?

(iii) $^{238}_{92}U$ decays producing helium atoms $^{4}_{2}He$. Write an nucleur equation for the reaction showing the other product.

41.

14. **Melting and Boiling Points**

Compound	M.Pt/^{o}C	B.Pt/^{o}C
X	5.5	80.1
Y	-114	-85.1
Z	712	1420.
P	681	1320.
Q	801	1470.
R	-23.0	76.8.

(i) Name the liquids at room temperature.

(ii) Name the gas at room temperature.

(iii) Name the probable molular structures.

(iv) List the schools which have a great structure.

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42.

15. Homologous Series : The Allcanes

Name	Molecular Formula	B.Pt/^{o}K
Methene	CH_4	111
Ethene	C_2H_6	184
Propane	C_3H_8	231
Pentane	C_5H_{12}	309
Heptane	C_7H_{16}	371
Octane	C_8H_{18}	399

(i) Plot a graph of B.Pt (y-axis) vs. no. of carbons atoms in molecule.

(ii) From the graph find the B.Pt of butance C4H10.

(iii) What is the formula of the hydrocarbon containing six atoms.

(iv) Explain the shape of the graph.

43. C.X.C. PHYSICS

1. Reflection : The Kaleidoscope

The number of images seen in two mirrors changes with the angle between the mirrors. Rosie tried the experiment and obtained these results.

Angle/^{o}	No. of Images (N)
120	2
90	3
60	5
45	7
30	11

(i) Plot the number of images (y-axis) vs. the angle.

(ii) Read off from the graph the angles required to give N = 9 and N = 4.

(iii) If the angle is 51^{o}, find N.

(iv) In a kaleidoscope the shape was placed between two mirrors at 60^{o}. Draw what you would see?

44.

2. Refractive Indices : Water and Glass

Johnny carried out a practical to find the refractive indices of water and glass by measuring the angles of incidence (i) and refraction (r).

Angle i	72	60	50	40	30	20
sine (i)	0.95	0.87	0.77	0.64	0.50	0.34
sine r glass	0.62	0.57	0.51	0.42	0.33	0.22
sinei $\hat{r}$ water	0.71	0.65	0.58	0.47	0.37	0.26

(i) Plot line graphs (a) sine i vs sine $\hat{r}$ (glass) (b) sine (i) vs. sine r (water).

(ii) From the gradients find the ratio sine i/sine r for glass and water.

(iii) What is the name given to this ratio?

(iv) For $\hat{i} = 35^{o}$, find $\hat{r}$ in both glass and water.

45.

3. Find Density: Wood and Plasticine

Janine was given $1cm^3$ blocks of wood and plasticine. She weighed different numbers of each. Her results were recorded as:-

No. of blocks	2	4	6	8	12	15	20
Mass of wood/g	1.4	2.9	4.3	5.6	8.3	10.6	14.2
Mass of Plasticine	2.6	5.3	7.7	10.4	15.7	19.8	26.4

(i) Plot the following mass (y-axis) vs. volume for (a) wood and (b) for plasticine.

(ii) Find the gradient of each line.

(iii) What is the density of wood and plasticine.

(iv) Which would float/sink in water?

(v) What is the mass of (1) 10 blocks of wood.
(2) 10 blocks of plasticine.

(vi) How many blocks make (1) 3.5g wood
(2) 21g of plasticine.

(vii) How many blocks of wood have the same mass as 7 blocks

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46.

4. **Measuring Time : The Pendulum**

A pendulum was varied in length. The time for one oscillation T was measured. A student obtained the following results.

(T) Time for one oscillation/s	2.82	2.38	2.01	1.84	1.62	1.20
l/m	0.96	1.44	1.00	0.95	0.64	0.36
$\sqrt{l}$	1.40	1.20	1.00	0.97	0.80	0.60

(i) Plot a graph of T (y-axis) vs $\sqrt{l}$.

(ii) Which ONE reading appears incorrect. Estimate the correct value.

(iii) Calculate the gradient of the line.

(iv) Find g from the formula

$$g = \frac{40}{(\text{gradient})^2}$$

(v) Estimate the time for ONE oscillation for a pendulum 80 ins. long.

47.

5. **Efficient Lifting : A Puzzle**

Alice was asked to find the minimum force needed to lift different masses placed at the end of a metre rule. Unfortunately, she had no known force F apart from the force of her hand pressing down on the ruler. Instead she lifted the mass by applying the force at different distances, d, until the mass just lifted. Her results were:-

Mass M /g	100	200	300	500	750	1000
Distance d/cm	8	15	25	41	60	79

47. Cont'd

(i) Plot a graph of mass M (y-axis) vs. d.

(ii) Where would she press down to lift a mass of 650g?

(iii) If she pressed down at the end of the ruler, d = 100, What mass could she lift?

(iv) From the gradient of the line find the value of the force F she applied ($g = 10m/s^2$).

48.

6. Exerting Pressure

Mary was asked by her teacher to find the average pressure P needed to push open an object. She did this by changing the area A and force F required. Her results were:-

Area A/m^2	0.01	0.04	0.09	0.16	0.25	0.36
Force F/N	0.5	2.1	4.6	8.1	12.4	17.9

(i) Plot a line graph Force F (y-axis) vs. Area A.

(ii) What force would be required for $A = 0.13m^2$.

(iii) Find the gradient of the line.

(iv) What is average pressure required.

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49.

7. Approximating g : An Easy Method

Geoffry was given different masses and asked to find the minimum force F needed to lift them using an accurate spring balance. His results were:-

Mass/Kg	0.1	0.2	0.5	1.0	2.0	5.0
Force F/N	1.0	1.9	4.9	9.9	19.9	49.2

(i) Plot the results Force F (y-axis) vs. Mass.

(ii) Find the gradient of the line.

(iii) From the gradient find an approximate value for g.

(iv) Draw a force diagram to explain how this method can be used to find g.

8. Finding Mass

A group of form 5 students were given an unknown Mass M. By applying different forces F and measuring the acceleration a each time, they were able to find M. How did they do it?

Force F/N	1.1	3.3	5.0	6.5	7.8	8.9	9.5	12.0
Acceleration a/m52	0.45	1.31	2.01	2.64	3.14	3.60	3.82	4.77

(i) Plot F (y-axis) vs. a.

(ii) Use the gradient to find the mass M.

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50.

9. Boyle's Law

A small column of air is trapped inside a strong glass tube by a column of oil. The pressure on the air is transmitted through the oil. The pressure on the air was varied and the volume of air measured each time. Andrew's results for this experiment were:-

Pressure P/KPa	110	100	90	83	76	71	65
Volume V/cm^3	45	50	55	60	65	70	75
P^V/KP cm^3							
1/P/KP^{-1}							

(i) Fill in the table with values for p^V and 1/p.

(ii) Plot a graph of PV against p.

(iii) Plot a graph of PV against 1/p.

(iv) What can you deduce from the graphs?

51.

10. Ohm's Law Experiments

Alice was given three electrical components X, Y and Z and asked to investigate the relationship between the voltage V and current I for each one. Her results were as follows:-

X

V/volts	Q.0	0.5	1.0	1.5	2.0	2.5	3.0
I/amps	0	0.16	0.34	0.50	0.67	0.83	1.01

Y

V/volts	0	0.5	1.0	1.5	2.0	2.5	3.0
I/amps	0	0.04	0.08	0.12	0.15	0.17	0.18

Z

V/volts	0	0.5	1.0	1.5	2.0	2.5	3.0
I/amps	0	0.25	0.50	0.76	1.05	1.30	1.64

51. Cont'd

(i) On seperate graph paper plot V vs. I for X, Y and Z.

(ii) From the straight line part of the graphs find RX, RY and RZ.

(iii) Explain the different shapes of the graphs.

(iv) Identify which component X, Y and Z is an ohmic resistor, thermistor and filucent lamp.

X is .....Y is ..... Z is .....

(v) Give reasons for your selection.

(vi) Draw the current diagram for the set up Alice used.

52.

11. Resistance Wire

Robin was asked to find the resistance per metre of Y and nechrome wire Z using an I/V current. His results were:-

Length/m	0.2	0.4	0.6	0.8	1.0	1.2
Resistance Ry	1.68	3.37	5.05	6.76	8.39	11.09
Resistance Rz	0.81	1.63	2.40	3.22	4.02	4.85

(i) Draw the circuit diagram Robin would use.

(ii) On the same graph plot Resistance (y-axis) vs. length.

(iii) Find the gradient for each line to give values of RY and RZ.

(iv) Robin made a rheostat of range 0 - 30 ohms. Which wire would he use? Why?

53.

12. Bouncing A Table Tennis Ball

James carried out an experiment to investigate how the behaviour of a table tennis ball changed with the surface. James dropped the ball from different heights (Release Height), RH) and measured how high it bounced back (BH) from a hard wood table. H repeated the experiment on a cork board. His results were:-

Release Height/m	1.5	1.3	1.1	0.9	0.7	0.5	0.3
Bounce Ht/m (wood)	0.98	0.86	0.72	0.61	0.48	0.35	0.22
" "/m (cork)	0.59	0.51	0.44	0.37	0.30	0.22	0.14

(i) On the same graph plot (y-axis) vs. BH for wood and cork.

(ii) If a ball was dropped from 1.0m how high will it bounce on wood and cork respectively.

(iii) If a ball was dropped from 0.6m on to wood how high would it bounce on the 2nd bounce?

(iv) Find the ratio RH/BH for cork and wood. Comment on the values.

(v) The ratio RH/BH is not constant. The ratio becomes smaller as RH increases, Explain.

54.

13. Rolling a Test Tube : Find the Circumference

John was told to find the accurate circumference of a test tube without using calipers. The teacher gave him a piece of cotton thread and a metre rule. How did he do it?

Method 1 By winding different numbers of TURNS of cotton thread around the tube.

Method 2 By ROLLING the tube along the bench and measuring the distance.

No. of TURNS	3	6	9	12	15	18	21
Length of thread/cm	15.3	20.7	45.9	62.0	77.0	92.0	107.1

54. Cont'd

No. of ROLLS	4	8	11	17	23	26	30
Distance/cm	19.3	38.7	52.0	81.0	108.1	122.0	140.5

(i) On separate graphs plot length vs. TURNS/ROLLS.

(ii) From the gradient find the average circumference for each method.

(iii) Generally the value for the ROLLING method is lower. Can you think why?

55.

14. Twisting a Magnet at a Distance

A bar-magnet was suspended from a cotton thread. A second magnet was moved various distances away from the suspended magnet. The suspended magnet deflected by an angle O from its original position for various values of d. A student's results were:-

Deflection O/^{o}	75	45	25	10	5	0	0
Distance d/cm	3	6	9	12	15	18	21

(i) Plot a graph of O (y-axis) vs. d.

(ii) At what distance would there be a deflection of 30^{o}?

(iii) Why does the deflection O vary with distance. Explain.

(iv) At what distance does the second magnet not affect the suspended one.

56. C.X.C. BIOLOGY

1. Temperature Control in Animals

The body temperature of a frog was monitored from 7am in the morning to 7 am in the evening. The ambiant air temperature in the Science laboratory was also noted. Cassandra who was in charge of the experiment also recorded her own body temperature during the day.

Air Temp.	16	20	29	21	19	18	14
Frog Temp.	14	18	26	19	16	13	16
Cassandra's Temp.	37.	37	36.9	36.9	37	37.5	37
Time (hrs.)	07.00	11.00	15.00	19.00	23.00	03.00	07.00

(1) What happens to the body temperature of the Frog as the external temperature increases?

(2) What happens to Cassandra' temp as the external temp. increases?

(3) From the graphs, what can you deduce about the activity of the student and the frog at night time?

(4) What advantage does this give one animal over the other in respect of night activities?

57.

2. Surface area to volume ratio

Small cubes of gelatin, containing immersal indicator were placed in testubes containing dilute acid, As the experiment progressed each cube gradually change colour (green to red). The results were as follows:-

Time to change colour (sec.)	60 sec.	120 sec.	180 sec.	240sec	300sec.
Volume of Gelatin Block	$1cm^3$	$2\ cm^3$	$3cm^3$	$4cm^3$	$5cm^3$

(1) Plot a line graph using the results.

(2) Explain the relationship between the volume of the block and the length of time to change colour.

(3) How is the above principle relevant to organisms living in an equation environment?

(4) How is the above principle relevant to terrestrial life?

58.

3. Respiration (1 active Acid production)

Lactic Acid conc. mg/100 cm^3 Blood	20	80	100	90	70	50	40
Time (mins.)	0	10	20	30	40	50	60

Shelford was asked to carry out some vigorous exercise for a period of 5 minutes. The lactic acid concentrate in his blood was then monitored for a period of one hour afterward.

(1) By how much did the lactic acid increase during the period of exercise.

(2) What was the care of lactic acid 67 minutes after commencing exercise?

(3) How could you find out the time it takes for the blood concentration of lactic acid to reach its original value of 20 mg/100cm^3 of blood?

59.

4. Temperature Regulation

Three conical flasks are filled with boiling water and prepared as follows:-

A - No covering

B - Cloth

C - Wetted Cloth.

The temperatures of flasks is then recorded over a period of time and the results tabulated.

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59. Cont'd

TIME (mins)	FLASK A C	FLASK B C	FLASK C C
1	94.0	98.0	89.4
2	93.2	98.5	87.5
3	92.4	97.2	86.5
4	91.5	96.6	85.6
5	90.6	96.3	84.6
6	89.8	95.5	83.6
7	89.0	95.3	82.5
8	88.0	94.6	80.5
9	87.0	90.3	79.4 78.5
10	86.0	90.4	76.4

(1) Plot the 3 answers using the results in the table.

(2) Which flask cooled down the quickest and why?

(3) Why did we need the results from flask A?

(4) How can these experiment results help us to understand temperature regulation in mammals?

60.

5. Patterns of Growth (Long-horned Grasshopper)

Length (cm)	Time (days)
1	0
1	2
1.	4
1.25	6
1.75	8
1.75	10
1.75	12
2.0	14
2.50	16

The table of results shows pattern of growth of a grasshopper over a period of 36 days.

(1) Plot a line graph.

(2) What do you find unusal about the growth of the grasshopper?

(3) Can you explain this?

(4) How long is each 'stage' of growth?

(5) Will this pattern continue all through the insects adult life.

(6) What are the problems associated with this type of growth pattern?

60. Cont'd

Length (cm)	Time (days)
2.50	18
2.50	20
2.75	22
3.0	24
3.0	26
3.0	28
3.5	30
3.75	32
3.75	34
3.75	36

(7) What do we call these different stages in the development of an insect.

(8) Name 4 insects which show this growth pattern (other than the grasshopper).

61.

6. Bugs and More bugs

A small petin chil containing nutrient agar was innoculated with a small number of Bactum and the population increase recorded over a period of several hours.

Numbers	50	100	200	400	800	1600	3200	6400	1280	2560
Time (mins)	0	30	60	90	120	150	180	210	240	270

(1) Plot the results in the form of a line graph.

(2) Estimate the population after 5 hours.

(3) Can you explain why the pop number increased in such a uniform manner.

(4) What would the population of Bactum be after a period of 135 mins?

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(5) Sketch a graph illustration what may happen to the pop after several days in petin chil.

(6) Can you explain your predictions. 48

(7) How can your graph be effected if Autolysis were to take place within the pop.

62.

7. Capillarity

Two long glass tubes were filled with sand and clay, and placed in a small dish of water. The rise of water up through the soil was measured three times during each day over a five day period. The results were as follows:-

Sand

Time (days)	DAY 1			DAY 2			DAY 3			DAY 4			DAY 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Level of Water (cm)	16	18	20	23	25	25	26	26	26	27	27	27	28	28	28

Clay

Time (days)	DAY 1			DAY 2			DAY 3			DAY 4			DAY 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Level of Water (cm)	5	7	10	27	29	32	35	35	36	38	38	38	40	40	40

A = Morning 9.00 a.m.

B = Lunch Time 12.00 a.m.

C = Afternoon 3.00 p.m.

(1) Which soil shows the greatest rise of water at the early stages of the experiment?

(2) Explain this result.

(3) Which soil shows the greatest rise at the end of the experiment?

(4) Explain this result.

(5) Capillarity is an important factor in the soil fertility, during times of draught. Explain this statement.

(6) Suggest crops that would benefit by growing in each of the alone soils.

63.

8. Movement through Membranes

A small cellophane membrane was placed over the end of a thistle funnel filled with sugar syrup. The level of liquid was noted. The thistle funnel was then placed in a beaker of distilled water. Over a period of several hours the level of liquid in the thistle funnel was noted.

Level of Liquid (cms)	0	3	9	12	20	23	24	24	23	24	24
Time (hrs.)	0	1	2	3	4	5	6	7	8	9	

(1) Plot a line graph from the table of results.

(2) Explain why there is an initial large amount of water across the membrane.

(3) By what process does this liquid move across the membrane, and briefly describe the process.

(4) Why does the graph level off after 5 to hours?

(5) Sketch a graph to show how the level of liquid would be effected after several more hours.

64.

9. Composition of Blood Plasma

Substance	% in Plasma	% Filtrate into Nephron	% in Urine
Water	90	90	96
Protein	7.0	0	0
Glucose	0.2	0.2	0
Sodium	0.3	0.3	0.4
Chloride	0.4	0.4	0.6
Urea	0.03	0.03	2.0
Uric Acid	0.004	0.004	0.05
Ammonia	0.001	0.001	0.04

64. Cont'd

From the above table answer the following questions:-

(1) Why do we see no protein or glucose in the urine?

(2) How might the concentration of sodium and chloride ions be effected after a period of strenuous exercise.

(3) Why is there a greater % of water in the urine than in the plasma?

(4) Why is there a greater % of Urea in the urine than in the plasma.

(5) How will such the blood composition vary if the person is suffering from diabetes.

(6) How will the blood composition change if the person eat a large amount of salt in his or her diet.

65.

10. Enzyme reaction rates (optimum ph levels)

Small pieces of black and white film negatives, of apparently similar surface area, are immersed in solutions of varying ph's with trypsin. The time for each film to completely clear is noted.

(NB: Gelatine is broken down by the action of trypsin).

Time to Clear (sec)	200	130	90	45	30	45	80	120	180
Test-tube ph.	1	1.5	.2	2.5	3	3.5	4.0	4.5	5.0

(1) Plot a line graph using the results (x-axis = ph)

(2) What is the option ph level for trypsin.

(3) Where would you find trypsin making in the alimentary canal?

(4) Explain why the ph inhibits the action of trypsin.

(5) Would the concentration of trypsin affect the results?

66.

11. Looking at exhaled air

The exhaled air of Wayne was tested while permitting various exercises during the Science lesson, and at rest. The results are shown below.

GAS	ORDINARY AIR (%)	Exhaled Air AT REST (%)	Exhaled Air DURING EXERCISES (%)
Oxygen	20	15	10
Carbon Dioxide	0.0333	4	6
Nitrogen	78	76	76
Water Vapour	Approx. 1	Approx 6	Approx. 8

From the table, answer the following questions.

(1) Why does the % concentration of Oxygen fall during exercise?

(2) Why does the % concentration of nitrogen not vary a great deal during the experiment?

(3) Why does the % concentration of Carbon Dioxide in exhaled air rise during exercise?

(4) How are the % concentration of the gases in ordinary air maintained at a fairly constant level.

(5) The % concentration of water vapour in the air varies a great deal from place to place and day to day, why is this so?

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12. A Balanced Diet

Dwight's kept a record of the food he ate for one day and worked out the total energy value for the days meals. The results are shown below:-

	PROTEIN (g)	FAT (g)	CARBOHYDRATE (g)	ENERGY VALUE (K)	CALCIUM (mg)	IRON (mg)	VIT C (yg)
FOOD							
Breakfast							
Banana	1.2	-	23	420	8	0.6	10
Bacon	25	55.0	1.0	2550	25	3.3	-
Egg	6	5	0.4	300	26	1.4	-
Bread	4	1.3	25	500	642	1.1	-
Butter	.06	8	.04	300	1.6	.02	-
Milk	2	2	2.2	120	56	.2	.7
Lunch							
Chocolate Milk	3	16	27	1100	108	2.0	-
Cheese	12	16	1	700	330	.4	0.2
Bread	4	1.3	25	500	42	1.1	-
Butter	.06	8	.04	300	1.6	.02	-
Dinner							
Fish	19.8	0.6	-	90	12	0.8	-
Rice	2.2	0.1	23	420	8	0.2	-
Cabbage	1.6	0.1	6	105	43	0.6	60
Tomato	0.5	-	4	44	7	0.2	-
Bread	4	1.3	25	500	42	1.1	-
Tea (with sugar)	2	1.5	20	310	40	.1	.3

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67. Cont'd Using the information given in the table, answer the following questions:

1. What was the total energy value of Dwights meals for this day menu?

2. Is his energy intake in excess of the daily requirement for a young growing adult?

3. Which foods provided him with the most energy?

4. Comment on the analysis of ordinary milk and chocolate milk. Why is there different results?

5. Which foods are rich in vitamin C? Why do we need a daily requirement of vitamin C and how is it used in the body.

6. Which type of meat is better for you, red meat or fish?

7. Which contains more energy, a cheese sandwich or fish, rice and cabbage dinner?

8. Is the diet of Dwight balance? Give reasons for your answer.

9. How might the occupation of an individual affect his type of diet? (i.e. sedentary, moderate active, very active).

10. Why are the minerals calcium and iron important in a balanced diet? Which foods contain a high iron content? Why is calcium important to growing school children.

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68.

13. Minerals and Growth in plants

Germinating bean seeds were grown in water cultures (Sach's Solutions) contain balanced amounts of salts considered necessary for plant growth, but being deficient in one element. The beans were then left to grow for a period of several weeks. Measurements were then taken of shoat length and dry mass of roots.

Shoat Length (cm)	27	24	26	11	33	3	27	24	30
Mineral Deficiency	Na	S	Mg	P	Fe	Ca	K	N	Complete

Root Mass (g)	8	4	5	3	7	1	5	4	10
Mineral Deficiency	Na	S	Mg	P	Fe	Ca	K	N	Complete

(1) Plot two graphs using the above results.

(2) Comment on the results for calcium deficiency.

(3) Which element seems to little effect the growth of the bean, why is this so?

(4) Why was a complete mineral culture included in the experiment?

(5) The length of shoat for the iron deficient culture was greater than that for the complete, why?

69.

14. The effect of Fluoride on Tooth Decay

Decay per 100 children	Fluoride care of water (ppm)
680	0.0
710	0.1
800	0.2
810	0.25
1000	0.27
700	0.3
590	0.35
470	0.37
410	0.4
400	0.5
360	0.6
350	0.7
2.30	1.0
2.40	1.1
2.30	1.2
250	1.3
300	1.4
310	1.7
300	1.9
260	2.0
230	2.5
270	3.0

Recent research has shown that fluoride salts in drinking water may have some effect on reducing dental decay. The table opposite shows the effect of fluoride care on tooth decay in children.

(N.B. Decay per 100 children means decayed, missing and filled teeth).

1. From the results plot the points and draw the best line.

2. Do you think there is a relationship between the incidence of dental decay and the fluoride content of water? If so, in what way?

3. What is the number of cavities per child where the water contains about 2 ppm of fluoride?

4. What is the number of cavities per child where the water contains 1.3 ppm of fluoride.

5. If the drinking water contains 0.1 ppm of fluoride, how much more fluoride would you need to add to the water to reduce the incidence of tooth decay by 75%?

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